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ABSTRACT

Six Arizona county libraries were chosen to participate in a study to investigate the effect of grants on local library funding support. The criteria set for choice of these libraries were: (1) the county library must be the strongest library in the county, (2) the library must have been chartered as a county library for at least three years prior to the 1970 census, (3) the county must be non-urban. Data are presented for local funding, federal and state grants, population, and assessed valuation for the fiscal years 70-71 through 75-76. Results of the analysis show that there is a high correlation between grant giving and local funding growth, while population growth bears no relationship to local funding growth. Tables and appendices are included. (AP)

THE EFFECT OF STATE AND FEDERAL GRANTS ON LOCAL LIBRARY FUNDING SUPPORT: A STATISTICAL ANALYSIS OF SIX RURAL ARIZONA COUNTIES

BY

Mark Evan Rorvig

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I. INTRODUCTION

The following study addresses four questions. 1) Does grant giving have an effect on local library funding support? 2) Can this effect be expressed statistically? 3) Is grant giving a more important variable in relation to local funding than population or assessed valuation? 4) what arguments, if any, can be made for correlations found or absent in the statistical analysis?

II. PREMISE

Logically, there should be positive correlation between the award of state and federal grants and the growth of local funding for a library. A grant should allow a library to provide services which their own resources would not allow. These additional services in turn should create a better community response to local funding increase requests which in turn allow the library to provide more services and so on. Briefly stated: as the performance of the library improves, the community in turn should provide greater support for the library. Grants affect this process by providing the initial, catalytic funds which allow the library to provide additional service in the first place.

Moreover, since a library without much visible presence in a community is unlikely to attract additional local funds, grant giving and local funding support should have a higher correlation than growth in the local tax base and growth in local funding. Finally, good library service is not (or should not be) contingent merely upon the size of the population served. Simply because more people move into a community does not mean that a library will receive more local funds. Indeed, almost the opposite could be expected, since extreme population growth would require that the library compete on a local basis for better transportation and waste disposal systems and other municipal improvements.

Two hypotheses about local library support thus emerge. First, that percent changes in local funds will be highly correlated with per cent changes in federal and state grant giving. And second, that this correlation will be higher than those between per cent changes in local funding and per cent changes in the local tax base or local population.

III. METHODOLOGY

A series of very common statistical measures exist with which to test hypotheses regarding variables of this type. For original data, six Arizona counties were selected on the basis of three criteria. One, the county library must be the strongest library in the county. Two, the library must have been chartered as a county library for at least three years prior to

the 1970 census. Three, the county must be non-urban. The third criteria was stipulated because it was felt that data taken from Arizona's two metropolitan counties, Pima and Maricopa, would tend to skew data from the rural areas which are vastly smaller in all respects in this state. In addition to this, local funds tend to flow into a newly formed county library at a much greater rate than for an established one. Finally, a county is a well defined service area which lends itself to the gathering of associated data on population and assessed valuation.

Table VI.1 presents data for local funding, federal and state grants, population and assessed valuation for the fiscal years 1970/1971 to 1975/1976. Per cent changes in these variables were calculated for each county for each year for five years, with 1970/1971 as the base year. These percent changes were then organized into a series of ordered arrays and further developed into a series of joint bi-variate distributions.

Pearson's r coefficient of correlation was selected to measure the precise relationship between these variables.

IV. COMMENTARY AND MATHEMATICAL EXPLANATION

On the whole, the past five years have witnessed substantial growth in local funding support, grants and assessed valuation for the six counties in this study. The following table indicates this growth.

Table III.1, Summary of Variables from Table VI.1

	Median	Dispersion	Mean	Standard Deviation
Local Funding	13.30%	43.55	17.55%	17.44
Grants	14.60%	75.95	22.93%	56.61
Population	4.75%	9.85	5.91%	4.34
Assessed Valuation	13.50%	18.80	13.9%	9.04

The values above should be interpreted according to these definitions. Median values indicate simply the mid-point of the ordered array of per centage changes for five years for six counties. The arithmetic mean however, is the sum of these changes divided by the number of items summed. Dispersion (usually referred to as D) indicates the difference between the value of data at the .90 percentile and .10 percentile of the ordered array. The standard deviation is the most complex of these measures and provides an indication of the distribution of data items about the arithmetic mean. It is calculated by taking the square root of the sum of the differences squared between the individual observations and the mean of the observations divided by the number of observations taken. Though it is

complex it is one of the most useful measures provided by statistics. With it for example, one can determine with simple arithmetic that 68% of the changes in year by year local funding were within the values 26.27% increases and 8.83% increases.

Pearson's coefficient of correlation assumes that data is normally distributed and that changes in one variable are directly related to changes in another. Pearson's r reveals that proportionate change in Y for every value of X.

Data were taken from Table VI.1 on per cent changes in year to year local funding, grants, population and assessed valuation for six counties for five years. Calculations were made for the values of X and Y in Tables VI.2, VI.3, VI.4 and formulated in VI.2.1, VI.3.1 and VI.4.1 The results are summarized below. Note that in all calculations, the X variable is always local funding.

Table III.2 Summary of r Values

Local funding and grants	r=0.9612
Local funding and population	r=0.1915
Local funding and valuation	r=0.9730

Since the sample size for all three correlations is identical, the value of r which must be exceeded to reject the null hypothesis for all three correlations at a .95 level of confidence with degree of freedom (N-2) on a one-tailed test is 0.311. The null hypothesis that any correlation is due to random chance is accepted only for the correlation of local funding and population. Scatter diagrams and trend calculations for all three correlations are displayed in VI.2.3, VI.3.3, VI.4.3 respectively

Scatter diagram VI.3.3 points out an interesting facet of the relationship between trend and the calculation for r. Local funding increases and population increases for this sample are both linear, in the sence that the plotted values follow quite closely on the trend line, but they are very disimilar as a proportionate change. Returning to the original summary of values in Table III.1, note the very great difference between the average rate of population growth and that of local library funding.

V. CONCLUSION

The chief benefit of statistics for this type of analysis is that it is possible to make statements about relationships between variables in an extremely precise way. For example, by describing specific incidents, it may be said that grant awards are an effective way to aid a library in obtaining new funds for new service programs. One could point to new children's programs or reference service which began with federal or state grants

and were later continued under local funds. But these claims would always be subject to additional questions about which program failed and which succeeded and where and what, and what percentage of programs were adopted and so forth. Statistics however, works only with numbers and classes of observations, which can be stated as concrete facts. These are much more difficult to refute than simple descriptions. Finally because statistics uses recorded facts in prescribed ways, other data may be assembled from other places and the findings replicated, fulfilling a basic tenet of the scientific method.

The first hypothesis stated that there would be a high positive correlation between grant giving and growth in local funding. This hypothesis was found to be true. It is important to remember however that correlation does not necessarily mean causation. For example, there have been studies which revealed a high degree of correlation between increases in the rise of ministers salaries in New England and increases in the price of rum in Cuba. Is there a sinister 'minister's league' which controls rum cartels? Certainly not, the cause of this correlation was simply world inflation.

But with regard to the second hypothesis that local funding and grants correlation would be higher than population or assessed valuation, it is certainly true that population increases bear little or no statistical relationship to local funding growth for these six counties. This finding is of high interest because population growth is often used as a primary justification for additional funds. For rural areas at least, this study would seem to indicate that it is performance or services rendered to the community which should be most important in a budget justification.

Assessed valuation, however, was also found to have a high degree of correlation with local funding, indicating that one of the potential causes of local funding growth is simply a growth in tax base. From this point forward, discussion must focus on arguments of causation and the purpose of grants in general.

As stated earlier, a grant allows a library to develop programs and services without risk. The risk of new programs is absorbed by the larger federal and state communities and not by the individual library or librarian. Moreover, once the local community appetite is whetted by better service, the community itself should wish to continue services.

On the other hand, it seems somewhat illogical that a growth in tax base alone would cause an average increase in local funds 4.1% greater than the average increase in the tax base itself. Perhaps increases in local funds could be attributed to active boards or library friends or a very energetic librarian. But in all these cases these bodies must still have something concrete to point to which the library has done that it has not done, or not done as well before a grant in order to deserve a greater share of local funds.

Accomplishments and performance generates more local funding, not mere faith that libraries are a good thing. (More important still, good faith

in this era of tight budgets is now, and will be less and less effective in securing funds.)

All this ties in to the importance of grants as an incentive for growth in local library budgets and service. It would be better in many ways if grants were not highly correlated with local funding support, or, if highly correlated, could not be logically supported by a strong argument of causation. Because if it is true that grants and their availability play a major role in local funding growth for libraries, then we must face the ominous possibility that this growth could not continue if grants and their risk support were not provided by the state and federal government. Fewer programs would be provided, and the public as whole would be disadvantaged.

In summation, there is a high correlation between grant giving and local funding growth. There is little or no correlation in this study between population growth and local support. A high correlation also exists between growth in assessed valuation and local funding, but does not have as strong an argument of causation as that for grants and local funding.

ACKNOWLEDGEMENTS

Credit is due to Professor Joseph Becker of the Center of Public Affairs at Arizona State University for suggesting this type of application for statistics. Mr. Sheldon Lawrence of the Arizona State Library Extension Service also deserves thanks for his assistance in assembling and verifying the original data and for his many helpful suggestions and comments regarding the significance of the findings.

VI. Tables and Appendices

Table VI.1 Original Data for Calculations

COCONINO	(1) Local Funds	% Change	(2) State & Federal Grants	% Change	(3) Population	% Change	(4) Assessed Valuation	% Change
1970/71	110,259	-	13,968	-	48,326	-	111,162,000	-
1971/1972	127,469	15.6	19,736	41.3	50,000	3.4	117,471,000	5.7
1972/1973	157,274	23.4	25,807	30.8	55,600	11.2	135,649,000	15.5
1973/1974	*163,523	4.0	52,172	102.2	62,700	12.8	167,754,000	23.7
1974/1975	185,620	13.5	54,122	3.7	65,000	3.7	226,199,000	34.8
1975/1976	269,961	31.2	52,692	(2.6)	67,200	3.3	320,290,000	41.6

GRAHAM

1970/1971	8,174	-	6,000	-	16,578	-	23,230,000	-
1971/1972	10,037	22.8	8,000	33.3	17,700	6.8	24,399,000	5.0
1972/1973	*14,499	44.5	13,784	72.3	18,000	1.7	25,025,000	2.6
1973/1974	13,863	(4.3)	31,161	126.1	18,000	0.0	29,886,000	19.4
1974/1975	16,090	16.1	29,711	(4.6)	19,600	8.9	35,541,000	18.9
1975/1976	17,300	7.5	20,828	(29.8)	20,500	4.6	38,731,000	9.0

*Includes Federal Revenue Sharing Funds

VI. Tables and Appendices

Table VI.1 Original Data for Calculations

MOHAVE	(1) Local Funds	% Change	(2) State & Federal Grants	% Change	(3) Population	% Change	(4) Assessed Valuation	% Change
1970/1971	45,925	-	15,195	-	25,857	-	111,792,000	-
1971/1972	50,300	9.5	17,780	17.0	31,100	20.3	116,876,000	4.5
1972/1973	*+76,541	52.2	16,225	(8.7)	31,500	1.3	120,289,000	2.9
1973/1974	77,423	1.2	30,271	86.6	34,300	8.8	139,904,000	16.3
1974/1975	98,345	27.0	18,299	(39.5)	36,600	6.7	164,950,000	17.9
1975/1976	112,602	14.5	14,540	(20.5)	38,400	4.9	191,021,000	15.8

PINAL								
1970/1971	44,000	-	12,132	-	68,579	-	176,028,000	-
1971/1972	46,003	4.6	14,520	19.7	73,500	7.2	208,486,000	18.4
1972/1973	51,044	11.0	16,854	16.1	77,800	5.8	231,329,000	10.9
1973/1974	54,417	6.6	29,717	76.3	80,500	3.5	241,964,000	4.6
1974/1975	56,779	4.3	19,686	(33.7)	84.500	5.0	263,901,000	9.1
1975/1976	57,388	1.1	20,332	3.3	89,500	5.9	319,236,000	21.0

*Indicates Federal Revenue Sharing Funds

+Source data incorrect in Arizona Public Libraries Statistical Report, verified from official county records

VI. Tables and Appendices

Table VI.1 Original Data for Calculations

YAVAPAI	(1) Local Funds	% Change	(2) State Federal Grants	% Change	(3) Population	Change	(4) Assessed Valuation	% Change
1970/1971	55,949	-	22,536	-	36,827	-	92,948,000	-
1971/1972	57,326	2.5	29,553	31.1	38,200	3.7	98,527,000	6.0
1972/1973	*83,084	44.9	20,636	(30.2)	42,500	11.2	112,804,000	14.5
1973/1974	90,596	9.0	50,139	143.0	47,400	11.5	138,774,000	23.0
1974/1975	*122,273	35.0	24,268	(106.6)	49,600	4.6	164,062,000	18.2
1975,1976	160,333	31.1	22,175	(8.2)	50,700	2.2	175,164,000	6.7

YUMA

1970/1971	178,684	-	24,372	-	60,827	-	180,870,000	-
1971/1972	202,106	13.1	27,560	13.1	67,000	10.1	115,958,000	6.5
1972/1973	235,525	16.5	28,064	1.8	66,400	(0.9)	123,298,000	6.3
1973/1974	227,486	(3.4)	51,108	82.1	68,300	2.9	138,772,000	12.5
1974/1975	296,369	68.0	25,510	(50.1)	71,000	3.9	163,489,000	17.8
1975/1976	305,385	3.1	56,763	122.5	72,600	2.2	176,127,000	8.0

*Indicates Federal Revenue Sharing Funds

Table VI.2.0 Table of values comparing variations in local funding and federal and state grants

X (Local Funds)	X^2	Y (Grants)	Y^2	XY
68.0	4624.00	143.0	20449.00	9724.00
52.5	2756.25	126.1	15901.21	6620.25
44.9	2016.01	122.5	15006.25	5500.25
44.5	1980.25	102.2	10444.84	4547.90
35.0	1225.00	86.6	7499.56	3031.00
31.2	973.44	82.1	6740.41	2561.52
31.1	967.21	76.3	5821.69	2372.93
27.0	729.00	72.3	5227.29	1952.10
23.4	547.56	41.3	1705.69	966.42
22.8	519.84	33.3	1108.89	759.24
16.5	272.25	31.1	967.21	513.15
16.1	259.21	30.8	948.64	495.88
15.6	243.36	19.7	388.09	307.32
14.5	210.25	17.0	289.00	246.50
13.5	182.25	16.1	259.21	217.35
13.1	171.61	13.1	171.61	171.61
11.0	121.00	3.7	13.69	40.70
9.5	90.25	3.3	10.89	31.25
9.0	81.00	1.8	3.24	16.20
7.5	56.25	-2.6	6.76	-19.50
6.6	43.56	-4.6	21.16	-30.36
4.6	21.16	-8.2	67.24	-37.72
4.3	18.49	-8.7	75.69	-37.41
4.0	16.00	-20.5	420.25	-82.00
3.1	9.61	-29.8	888.04	-92.38
2.5	6.25	-30.2	912.04	-75.50
1.2	1.44	-33.7	1135.69	-40.44
1.1	1.21	-39.5	1560.25	-43.45
-3.4	11.56	-50.1	2510.01	170.34
-4.3	18.49	-106.6	11363.56	458.38

VI.2.1 Local Funding and Grants Summary of Values from Table VI.2.0

$\Sigma X=526.4 \quad \Sigma X^2=18173.76 \quad \Sigma Y=687.8 \quad \Sigma Y^2=111917.10 \quad \Sigma XY=40245.53 \quad N=30$

$$r = \frac{40245.5 - \frac{(526.4)(687.8)}{30}}{\sqrt{(18173.8 - \frac{277097}{30})(111917 - \frac{473079}{30})}}$$

$$r = \frac{40245.5 - \frac{362058}{30}}{\sqrt{(18173.8-9236.6)(111917-15769)}}$$

$$r = \frac{28176.9}{\sqrt{(8937.2)(96148)}}$$

$$r = \frac{28176.9}{\sqrt{859293905.6}}$$

$$r = \frac{28176.9}{29313.7153} = 0.9612$$

VI.2.2 Local Funding and Grants $Y=a+bX$

Trend Analysis: A. $\Sigma Y=Na+\Sigma Xb$

B. $\Sigma XY=\Sigma Xa+\Sigma X^2b$

Substituting values

A. $688=30a+526b$

B. $40245=526a+18174b$

Clearing for a $(526b\div 30a=17.53)$

$17.53(688=30a+526b)=(12061=526a+9221b)$

Subracting A. from B. to eliminate a

B. $40245=526a+18174b$

A. $12061=526a+9221b$

$28184=0+8953b$

$3.15=b$

Substituting b to solve for a

B. $40245=526a+18174(3.15)$

$40245=526a+57248$

$40245-57248=526a+57248-57248$

$-17003=526a$

$-32.32=a$

Filling values for a&b into equation for trend equation yields

$Y=(-32.32)+3.15X)$

LOCAL FUNDING AND GRANTS

VI.2.3

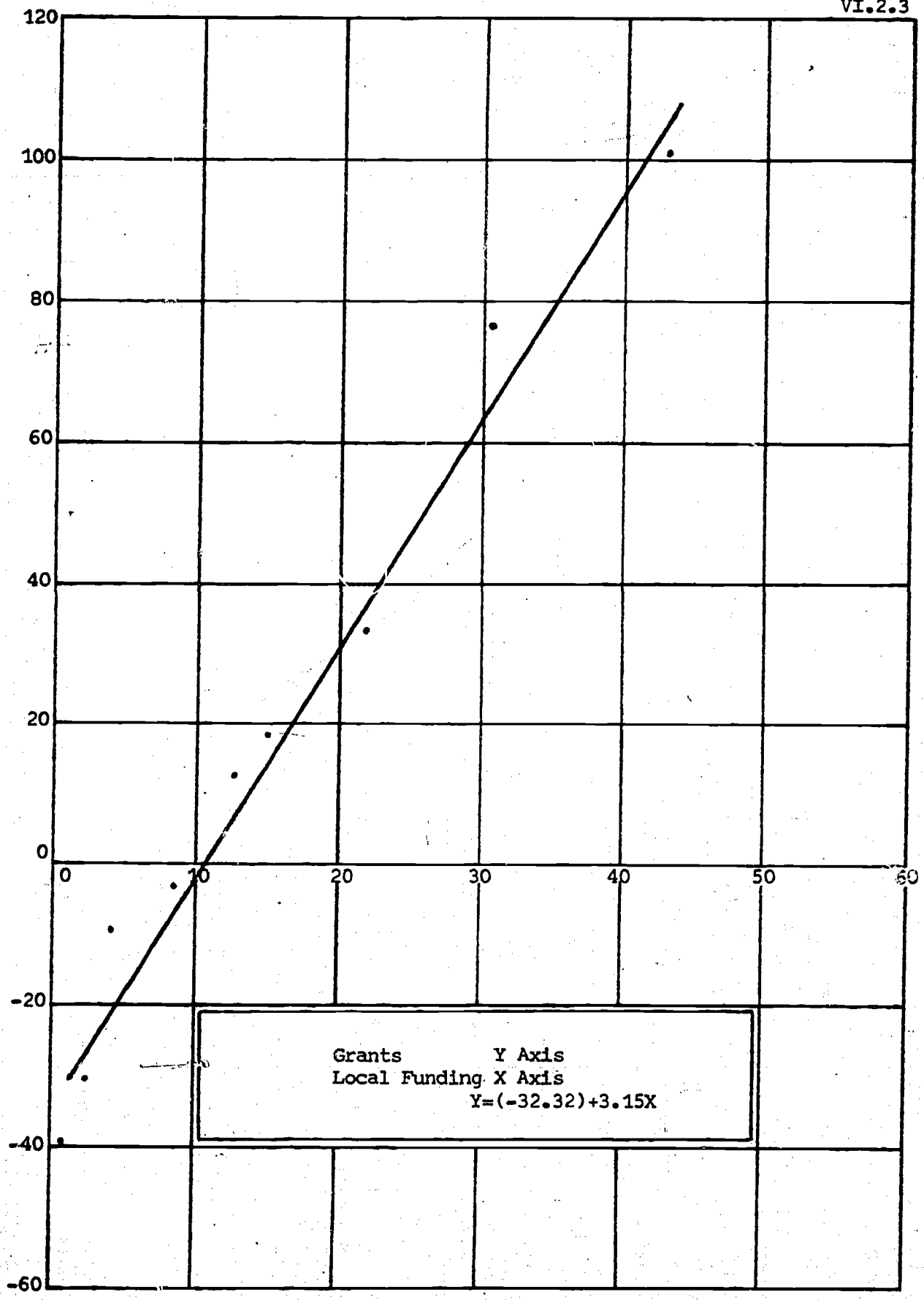


Table of Values Comparing
Table VI.3.0 Variations in local funding and population growth

X (Local Funds)	X^2	Y(Pop.)	Y^2	XY
68.0	4624.00	20.3	412.09	1380.40
52.5	2756.25	12.8	163.84	672.00
44.9	2016.01	11.5	132.25	516.35
44.5	1980.25	11.2	125.44	498.40
35.0	1225.00	11.2	125.44	392.00
31.2	973.44	10.1	102.01	315.12
31.1	967.21	8.9	79.21	276.79
27.0	729.00	8.8	77.44	237.60
23.4	547.56	7.2	51.84	168.48
22.8	519.84	6.8	46.24	155.04
16.5	272.25	6.7	44.89	110.55
16.1	259.21	5.9	34.81	94.99
15.6	243.36	5.8	33.64	90.48
14.5	210.25	5.0	25.00	72.50
13.5	182.25	4.9	24.01	66.15
13.1	171.61	4.6	21.16	60.26
11.0	121.00	4.6	21.16	50.60
9.5	90.25	3.9	15.21	37.05
9.0	81.00	3.7	13.69	33.30
7.5	56.25	3.7	13.69	27.75
6.6	43.56	3.5	12.25	23.10
4.6	21.16	3.4	11.56	15.64
4.3	18.49	3.3	10.89	14.19
4.0	16.00	2.9	8.41	11.60
3.1	9.61	2.2	4.84	6.82
2.5	6.25	2.2	4.84	5.50
1.2	1.44	1.7	2.89	2.04
1.1	1.21	1.3	1.69	1.43
-3.4	11.56	0.0	0.00	0.00
-4.3	18.49	-0.9	0.81	-3.87

Local Funding and Population

VI.3.1 Summary of Values from Table VI.3.0

$\Sigma X = 526.4 \quad \Sigma X^2 = 18173.76 \quad \Sigma Y = 177.2 \quad \Sigma Y^2 = 1621.24 \quad \Sigma XY = 5332.26 \quad N = 30$

$$r = \frac{5332.3 - \frac{(526.4)(177.2)}{30}}{\sqrt{(18173.8 - \frac{277097}{30})(16121.2 - \frac{31400}{30})}}$$

$$r = \frac{5332.3 - 3109.3}{\sqrt{(18173.8 - 9236.6)(16121.2 - 1046.7)}}$$

$$r = \frac{2223}{\sqrt{(8937.2)(15074.5)}}$$

$$r = \frac{2223}{\sqrt{134723811.3}}$$

$$r = \frac{2223}{11607.06} = 0.1915$$

VI.3.2 Local Funding and Population $Y=a+bX$

Trend Analysis: A. $\Sigma Y=N a+\Sigma Xb$

B. $\Sigma XY=\Sigma Xa+\Sigma X^2 b$

Substituting values from Table 2.

A. $177=30a+526b$

B. $5332=526a+18174b$

Clearing for a $(526b \div 30a=17.53)$

$17.53(177=30a+526b)=(3103=526a+9221b)$

Subtracting A. from B. to eliminate a

B. $5332=526a+18174b$

A. $310=526a+9221b$

$2229=0+8953b$

$0.25=b$

Substituting b to solve for a

B. $5332=526a+18174(0.25)$

$5332=526a+4543$

$(-4543)-5332=526a+4543-(-4543)$

$789=526a$

$1.5=a$

$Y=1.5+0.25X$

LOCAL FUNDING AND POPULATION

VI.3.3

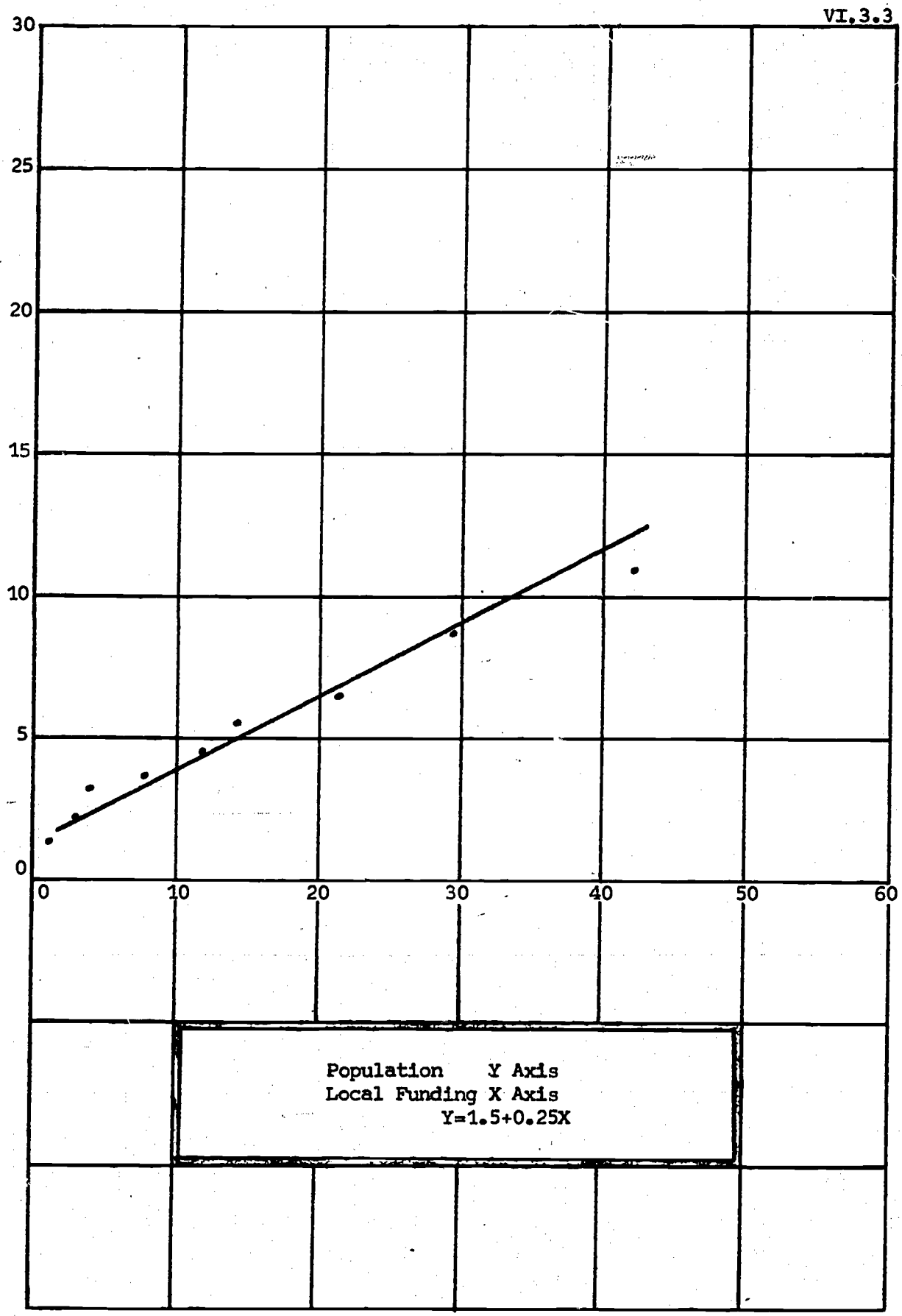


Table of Values Comparing

Table IV.4.0 Variations in local funding and assessed valuation

X (Local Funds)	X^2	Y (Valuation)	Y^2	XY
68.0	4624.00	41.6	1730.56	2828.80
52.5	2756.25	34.8	1211.04	1827.00
44.9	2016.01	23.7	561.69	1064.13
44.5	1980.25	23.0	529.00	1023.50
35.0	1225.00	21.0	441.00	735.00
31.2	973.44	19.4	376.36	605.28
31.1	967.21	18.9	357.21	587.79
27.0	729.00	18.4	338.56	496.80
23.4	547.56	18.2	331.24	425.88
22.8	519.84	17.9	320.41	408.12
16.5	272.25	17.8	316.84	293.70
16.1	259.21	16.3	265.69	262.43
15.6	243.36	15.8	249.64	246.48
14.5	210.25	15.5	240.25	224.75
13.5	182.25	14.5	210.25	195.75
13.1	171.61	12.5	156.25	163.75
11.0	121.00	10.9	118.81	119.90
9.5	90.25	9.1	82.82	86.45
9.0	81.00	9.0	81.00	81.00
7.5	56.25	8.0	64.00	60.00
6.6	43.56	6.7	44.89	44.22
4.6	21.16	6.5	42.25	29.90
4.3	18.49	6.3	39.69	27.09
4.0	16.00	6.0	36.00	24.00
3.1	9.61	5.7	32.49	17.67
2.5	6.25	5.0	25.00	12.50
1.2	1.44	4.6	21.16	5.52
1.1	1.21	4.5	20.25	4.95
-3.4	11.56	2.9	8.41	-9.86
-4.3	18.49	2.6	6.76	-11.18

Local Funding and Assessed Valuation

VI.4.1 Summary of Values from Table VI.4.0

$\Sigma X=526.4 \quad \Sigma X^2=18173.76 \quad \Sigma Y=417.1 \quad \Sigma Y^2=8259.52 \quad \Sigma XY=11881.32 \quad N=30$

$$r = \frac{11881.3 - \frac{(526.4)(417.1)}{30}}{\sqrt{(18173.8 - \frac{(526.4)^2}{30})(8259.52 - \frac{(417.1)^2}{30})}}$$

$$r = \frac{11881.3 - 7318.7}{\sqrt{(18173.8 - 9236.6)(8259.52 - 5799.1)}}$$

$$r = \frac{4562.6}{\sqrt{(8937.2)(2460.4)}}$$

$$r = \frac{4562.6}{\sqrt{21989086}}$$

$$r = \frac{4562.6}{4689.25} = .9730$$

VI.4.2 Local Funding and Assessed Valuation $Y=a+bX$

Trend Analysis: A. $\Sigma Y=Na+\Sigma Xb$

B. $\Sigma XY=\Sigma Xa+\Sigma X^2b$

Substituting values from Table 3

A. $417=30a+526b$

B. $11881=526a+18174b$

Clearing for a $(526\div 30a=17.53)$

$17.53(417=30a+526b)-(7310=526a+9221b)$

Subtracting A. from B. to determine b

B. $11881=526a+18174b$

A. $7310=526a+9221b$

$4571=0+8953b$

$0.51=b$

Substituting b to solve for a

B. $11881=526a+18174(0.51)$

$11881=526a+9269$

$(-9269)-11881=526a+9269-(-9269)$

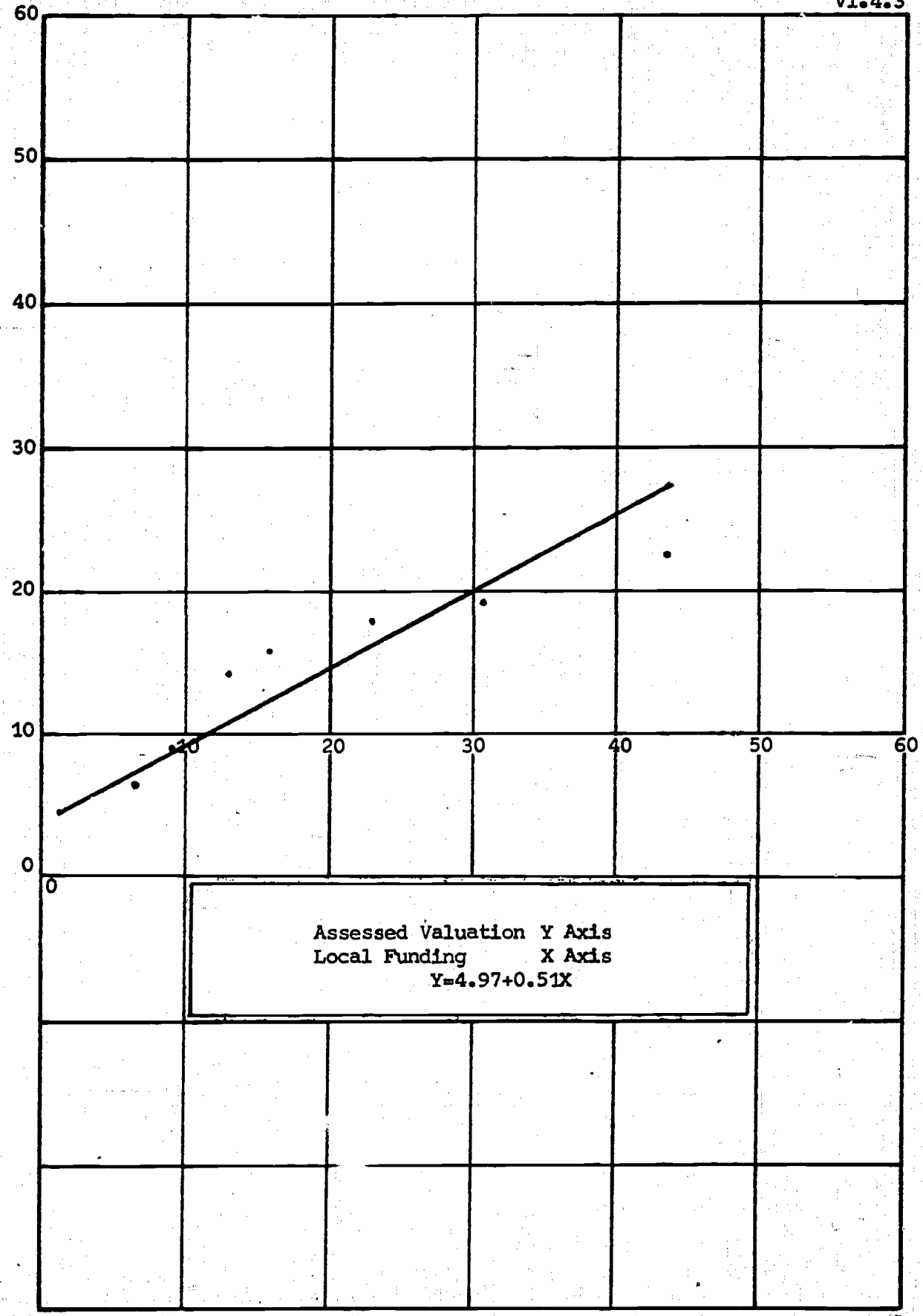
$2612=526a$

$4.97=a$

$Y=4.97+0.51X$

LOCAL FUNDING AND ASSESSED VALUATION

VI.4.3



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VII Footnotes

1. Data Source: Arizona State Library Extension Service, Arizona Public Libraries Statistical Report and Directory, 1970/1971, 1971/1972, 1972/1973, 1973/1974, 1974/1975, 1975/1976, (from gallery proofs).

2. IBID.

3. Valley National Bank of Arizona, Arizona Statistical Review, 1970, 1971, 1972, 1973, 1974, 1975, 1976.

4. IBID.

5. Freeman, Linton C., Elementary Applied Statistics, John Wiley And Sons, New York, March 1968, p. 63.

   Formula for standard deviation is:

$$s = \sqrt{\frac{\Sigma(X-\bar{X})^2}{N}}$$

6. IBID., p. 103.

   Formula for Pearson's r is:

$$r = \frac{\Sigma XY - \frac{(\Sigma X)(\Sigma Y)}{N}}{\sqrt{(\Sigma X^2 - \frac{(\Sigma X)^2}{N})(\Sigma Y^2 - \frac{(\Sigma Y)^2}{N})}}$$